10 CFR 50.73

**Boston Edison**

Pilgrim Nuclear Power Station
Rocky Hill Road
Plymouth, Massachusetts 02360

**E. T. Boulette, PhD**
Senior Vice President – Nuclear

May 1, 1997
BECo Ltr. 2.97. 050

U.S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, D.C. 20555

Docket No. 50-293
License No. DPR-35

The enclosed Licensee Event Report (LER) 97-007-00, "Safeguards Buses De-Energized and Losses of Off-Site Power During Severe Storm While Shut Down", is submitted in accordance with 10 CFR Part 50.73.

This letter contains no commitments.

Please do not hesitate to contact me if there are any questions regarding this report.

for E. T. Boulette, PhD

DWE/lb/9700700

Enclosure: LER 97-007-00

cc: Mr. Hubert J. Miller
Regional Administrator, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Sr. NRC Resident Inspector - Pilgrim Station

Standard BECo LER Distribution

IE 22

# CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9705130019 DOC.DATE: 97/05/01 NOTARIZED: NO DOCKET #
FACIL:50-293 Pilgrim Nuclear Power Station, Unit 1, Boston Edison 05000293
AUTH.NAME AUTHOR AFFILIATION
ELLIS,D.W. Boston Edison Co.
BOULETTE,E.T. Boston Edison Co.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-007-00:on 970401,safeguard buses were de-energized due to severe storm.Replacement of microprocessor control units installed in voltage regulating transformers.W/970501 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 23
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

| | RECIPIENT ID CODE/NAME | COPIES LTTR | COPIES ENCL | RECIPIENT ID CODE/NAME | COPIES LTTR | COPIES ENCL |
|---|---|---|---|---|---|---|
| | PD1-3 PD | 1 | 1 | WANG,A. | 1 | 1 |
| INTERNAL: | ACRS | 1 | 1 | AEOD/SPD/RAB | 2 | 2 |
| | AEOD/SPD/RRAB | 1 | 1 | FILE CENTER | 1 | 1 |
| | NRR/DE/ECGB | 1 | 1 | NRR/DE/EELB | 1 | 1 |
| | NRR/DE/EMEB | 1 | 1 | NRR/DRCH/HHFB | 1 | 1 |
| | NRR/DRCH/HICB | 1 | 1 | NRR/DRCH/HOLB | 1 | 1 |
| | NRR/DRCH/HQMB | 1 | 1 | NRR/DRPM/PECB | 1 | 1 |
| | NRR/DSSA/SPLB | 1 | 1 | NRR/DSSA/SRXB | 1 | 1 |
| | RES/DET/EIB | 1 | 1 | RGN1 FILE 01 | 1 | 1 |
| EXTERNAL: | L ST LOBBY WARD | 1 | 1 | LITCO BRYCE,J H | 1 | 1 |
| | NOAC POORE,W. | 1 | 1 | NOAC QUEENER,DS | 1 | 1 |
| | NRC PDR | 1 | 1 | NUDOCS FULL TXT | 1 | 1 |

NOTE TO ALL "RIDS" RECIPIENTS:
PLEASE HELP US TO REDUCE WASTE. TO HAVE YOUR NAME OR ORGANIZATION REMOVED FROM DISTRIBUTION LISTS OR REDUCE THE NUMBER OF COPIES RECEIVED BY YOU OR YOUR ORGANIZATION, CONTACT THE DOCUMENT CONTROL DESK (DCD) ON EXTENSION 415-2083

FULL TEXT CONVERSION REQUIRED
TOTAL NUMBER OF COPIES REQUIRED: LTTR 25 ENCL 25

NRC Form 366 (4-95)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104
EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

# LICENSEE EVENT REPORT (LER)

(See reverse for number of digits/characters for each block)

1086

| FACILITY NAME (1) | DOCKET NUMBER (2) | PAGE(3) |
|---|---|---|
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 1 of 22 |

**TITLE (4)**
Safeguards Buses De-Energized and Losses of Off-Site Power During Severe Storm While Shut Down

| EVENT DATE (5) | | | LER NUMBER (6) | | | REPORT DATE (7) | | | OTHER FACILITIES INVOLVED (8) | |
|---|---|---|---|---|---|---|---|---|---|---|
| MONTH | DAY | YEAR | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | MONTH | DAY | YEAR | FACILITY NAME | DOCKET NUMBER |
| | | | | | | | | | N/A | 05000 |
| 04 | 01 | 97 | 97 | 007 | 00 | 05 | 01 | 97 | FACILITY NAME: N/A | DOCKET NUMBER: 05000 |

| OPERATING MODE (9) | N | THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (Check one or more) (11) | | | | | |
|---|---|---|---|---|---|---|---|
| POWER LEVEL (10) | 000 | 20.2201 (b) | | 20.2203(a)(2)(v) | | 50.73(a)(2)(i) | 50.73(a)(2)(viii) |
| | | 22.2203(a)(1) | | 20.2203(a)(3)(i) | X | 50.73(a)(2)(ii)(B) | 50.73(a)(2)(x) |
| | | 20.2203(a)(2)(i) | | 20.2203(a)(3)(ii) | | 50.73(a)(2)(iii) | 73.71 |
| | | 20.2203(a)(2)(ii) | | 20.2203(a)(4) | X | 50.73(a)(2)(iv) | OTHER |
| | | 20.2203(a)(2)(iii) | | 50.36(c)(1) | | 50.73(a)(2)(v) | Specify in Abstract below or in NRC Form 366A |
| | | 20.2203(a)(2)(iv) | | 50.36(c)(2) | X | 50.73(a)(2)(vii)(D) | |

**LICENSEE CONTACT FOR THIS LER (12)**

| NAME | TELEPHONE NUMBER (Include Area Code) |
|---|---|
| Douglas W. Ellis - Principal Engineer | (508) 830-8160 |

**COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)**

| CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS | | CAUSE | SYSTEM | COMPONENT | MANUFACTURER | REPORTABLE TO NPRDS |
|---|---|---|---|---|---|---|---|---|---|---|
| B | EA | XFMR | R439 | Y | | | | | | |
| | | | | | | | | | | |

| SUPPLEMENTAL REPORT EXPECTED (14) | | | EXPECTED SUBMISSION DATE(15) | MONTH | DAY | YEAR |
|---|---|---|---|---|---|---|
| YES (If yes, complete EXPECTED SUBMISSION DATE) | X | NO | | | | |


**ABSTRACT** (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

On April 1, 1997, both 120 volt safeguards buses de-energized on two occasions, and subsequently, a loss of preferred off-site power (345 Kv) followed later by a loss of secondary off-site power (23 Kv) occurred while the emergency diesel generators were in operation during a severe storm (blizzard). An Unusual Event was declared at 0349 hours and was terminated at 2347 hours by which time the secondary and preferred off-site power sources were re-energized .

The cause of the de-energizing of the safeguards buses was brief, severe 345 Kv transmission system undervoltage transients that resulted in automatic shut downs of the voltage regulating transformers (480/120 volt) that power the safeguards buses. The transformers' purchase specification did not address and the manufacturer and supplier documentation did not identify an automatic shut down feature if input voltage was less than 384 volts (greater than zero volts). The separate losses of the off-site power sources were caused by the effects of the storm.

Corrective action taken included the replacement of the microprocessor control units installed in the voltage regulating transformers.

The events occurred while in cold shut down. The reactor mode selector switch was in the REFUEL position. The events posed no threat to public health and safety.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 2 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

BACKGROUND

The 1997 refueling outage began on February 15, 1997. As part of preparation and planning for the refueling outage, temporary procedure TP 96-049, "RFO 11 Compensatory Measures," was prepared and approved prior to the refueling outage. In summary, the procedure provided operations personnel with an overview of the refueling outage schedule and identified vulnerability to loss of off-site power and decay heat removal capability, compensatory measures (event based), and available compensatory systems (symptom based). Moreover, the procedure included attachments that include loss off-site power, contingency for a loss of shutdown cooling, temporary power feeding plant equipment, and outage safety review.

On the morning of March 31, 1997, procedure 2.1.37, "Coastal Storm - Preparations and Actions," was entered because of the forecasted arrival of a severe storm later in the day. Scheduled maintenance and surveillance activities were suspended and actions initiated to prepare for the storm.

Conditions existing prior to the event were as follows.

- The preferred source of off-site power, 345 Kv transmission lines 342 and 355, was energized. The 345 Kv switchyard air circuit breakers ACBs 102, 103, 104 and 105 were closed. The startup transformer (SUT) was energized from lines 342 (via ACB-103) and 355 (via ACB-102). A new main transformer had been moved onto its platform but was neither electrically nor mechanically connected, and the unit auxiliary transformer was not available because of the main transformer status. Located at the end of this report is a simplified single line drawing of the 345 Kv switchyard.

- The secondary source of off-site power, the 23 Kv distribution line, was energized. The shutdown transformer, station blackout diesel generator, and related 4.16 Kv Bus A8 were in standby service.

- The 4.16 Kv auxiliary power distribution system Buses A1 through A6 were energized from the SUT. Emergency diesel generators 'A' and 'B' were in standby service. Safety-related 480 volt swing Bus B6 was in its normal alignment, powered from Bus A5 via 480 volt load center B1.

- The reactor vessel was fueled, and the reactor head was installed and tensioned. The reactor water level was being maintained in the range of 175 - 180 inches (wide range), and the water temperature was being maintained in the range of 120 - 130 degrees Fahrenheit. The reactor mode selector switch was in the REFUEL position. The recirculation system pumps 'A' and 'B' were not in service. The suppression pool water level, at approximately 136", was higher than normal in support of the replacement of the suction strainers for the residual heat removal and core spray systems pumps.

- The residual heat removal (RHR) system train 'B' was in the shutdown cooling mode of operation.

- The reactor water cleanup (RWCU) system was in service.

- The salt service water (SSW) system train 'B' pump P-208D and one pump in each of the two reactor building closed cooling water (RBCCW) system trains were in service.

- The reactor protection system (RPS) motor generator sets 'A' and 'B' were powered from their normal power sources -- set 'A' from Bus A3 via 480 volt load center B3 and motor control center (MCC) B23 and set 'B' from Bus A4 via load center B4 and MCC-B22.

- The spent fuel pool cooling system was in service with the spent fuel pool temperature at 82 degrees Fahrenheit.

- The air-operated switchyard sump pumps were installed for use in the event of a loss of the preferred off-site 345 Kv power source.

Early in the afternoon, as the storm approached, the senior shift licensed operator (NWE) conferred with senior operations management and outage management, and a decision was made to suspend all testing which could affect on-site or off-site power sources. Throughout the afternoon, the NWE directed a further reduction in the reactor vessel water temperature band (to 95 to 105 degrees Fahrenheit), a reduction in the reactor vessel water level band (to 90" - 100"), and provision for an additional reactor vessel vent path. These actions were taken in anticipation of a potential loss of off-site power. Oncoming shift crews were briefed by the NWE and senior operations management on procedures 2.1.37, "Coastal Storm - Preparations and Actions," 5.2.2, "High Winds," 2.4.16, "Distribution Alignment Electrical System Malfunctions," and 2.4.25, "Loss of Shutdown Cooling."

By 1923 hours, weather conditions were as follows: winds from the northeast at approximately 40 - 50 mph with gusts to about 60 mph; moderate to heavy rain; and temperatures nearing 32 degrees Fahrenheit (and decreasing). The precipitation changed to snow by about 2100 hours. Sporadic thunder and lightning was experienced in the region and general area of Pilgrim Station.

At 2221 hours, ACBs 102 and 105 automatically tripped (opened), line 355 de-energized and re-energized, and ACB-102 automatically reclosed. ACB-105 remained open as designed. The event was consistent with transmission system electrical protection design and transmission system disturbances being experienced during the storm. An employee report of arcing in the switchyard or a possible lightning strike prompted a walkdown of the switchyard. The walkdown revealed no evidence of arcing or lightning strike. After the walkdown, ACB-105 was reclosed in accordance with regional power authority (REMVEC) switching orders. The closing of ACB-105 re-established the 345 Kv ring bus.

Meteorological indications from the 220' meteorological tower were lost at 2320 hours. The probable cause was a lightning strike to the tower. Indications from the 160' meteorological tower were not affected.

On April 1, 1997, at 0135 hours, ACBs 102 and 105 tripped automatically, line 355 de-energized and re-energized, and ACB-102 automatically reclosed as designed. ACB-105 remained open as designed.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 4 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

EVENT DESCRIPTION

On April 1, 1997, at 0135 hours, the safety-related 120 volt (alternating current) safeguards control power Bus 'A' panels Y3 and Y31, and Bus 'B' panels Y4 and Y41 de-energized while the 4.16 Kv distribution system including safety-related Buses A5 and A6 and related electrical system were energized from the 345 Kv transmission system via the SUT.

Panels Y3/31 are powered from Bus A5 via 480 volt load center B1, MCC-B17, and 480/120 volt regulating transformer X55. Similarly, panels Y4/41 are powered from Bus A6 via 480 volt load center B2, MCC-B18, and 480/120 volt regulating transformer X56. Circuits powered from panels Y3 and Y4 include normally energized trip and/or control logic relays that are part of the primary containment isolation control system (PCIS) and reactor building isolation control system (RBIS), and pressure switches that monitor the header pressure of the salt service water (SSW) and reactor building closed cooling water (RBCCW) systems. The de-energizing of panels Y3 and Y4 resulted in:

- A PCIS Group 6 isolation signal and resultant automatic closing of the RWCU system isolation valves MO-1201-2 , MO-1201-5, MO-1201-80, trip of the RWCU pump that was in service, and interruption in RWCU system operation.

- An RBIS isolation signal and resultant automatic start of the standby gas treatment system (SGTS) trains 'A' and 'B' and automatic closing of the reactor building ventilation supply and exhaust dampers.

The salt service water SSW pump P-208D and the RBCCW pumps in trains 'A' and 'B' that were in service at the time of the event stopped.

Utility licensed operator response was in accordance with alarm response procedures and operator training. SSW pump P-208D and one pump each RBCCW train were manually started via their control switches about 20 - 30 seconds after the pumps stopped. The safeguards panels had de-energized because regulating transformers X55 and X56 had automatically shut down. Regulating transformer X55 was reset in accordance with procedure 5.3.18 (rev. 14), "Loss of 120 VAC Safeguards Buses Y3 and Y31." Regulating transformer X56 was reset in accordance with procedure 5.3.19 (rev. 14), "Loss of 120 VAC Safeguards Buses Y4 and Y41." Panels Y3/31 and Y4/41 were re-energized by 0156 hours. After the PCIS Group 6 circuitry was reset, the RWCU system was returned to service by 0159 hours.

At 0209 hours, ACB-102 automatically tripped and reclosed when line 355 was energized. ACB-105 was still open. Panels Y3/31 and Y4/41 de-energized. The de-energizing of panels Y3 and Y4 resulted in:

- A PCIS Group 6 isolation signal and resultant automatic closing of the RWCU system isolation valves, trip of the RWCU pump that was in service, and interruption in RWCU system operation.

- An RBIS isolation signal. The SGTS remained in operation, and the reactor building ventilation system dampers remained closed as designed.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 5 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The SSW and RBCCW systems pumps that were in service stopped. The affected SSW and RBCCW pumps were manually started about 20 - 30 seconds after the pumps stopped.

The safeguards panels had de-energized because regulating transformers X55 and X56 had automatically shut down. By 0214 hours, regulating transformers X55 and X56 were reset in accordance with procedures 5.3.18 and 5.3.19, and panels Y3/31 and Y4/41 were re-energized. After the PCIS Group 6 circuitry was reset, the RWCU system was returned to service. After the RBIS circuitry was reset, the SGTS was returned to standby service, and the reactor building ventilation system was returned to normal service by 0219 hours.

At 0225 hours, ACB-102 was tagged open with its automatic reclosure feature tagged off in accordance with REMVEC switching orders. This action, in conjunction with ACB-105 that was open, effectively removed line 355 as a source of power to the SUT and left line 342 (via ACB-103) as the source of power to the SUT. ACB-105 was not closed because of an intermittent fault(s) on line 355.

Emergency diesel generator (EDG) 'A' was started in accordance with procedure 2.4.144, "Degraded Voltage," at 0234 hours. After synchronizing EDG 'A' onto Bus A5, the feeder breaker to Bus A5 from the SUT was opened and EDG 'A' was put into the isochronous mode of operation at 0236 hours. EDG 'B' was started in accordance with procedure 2.4.144 at 0237 hours. After sychronizing EDG 'B' onto Bus A6, the feeder breaker to Bus A6 from the SUT was opened and EDG 'B' was put into the isochronous mode of operation at 0238 hours. These actions were taken because of electrical disturbances on the 345 transmission system and the loss of line 355 as a source of power to the SUT, and the actions were in accordance with procedure 5.2.2.

At 0257 hours, ACB-103 automatically tripped (opened) and remained open, line 342 de-energized, and ACB-104 remained closed. The opening of ACB-103 was accompanied by alarms including control room panel C3L (window A-7), "Startup Transformer Lockout." The opening of ACB-103 and SUT lockout removed line 342 as the source of power to the SUT and resulted in the de-energizing of the SUT and nonsafety-related 4.16 Kv Buses A1, A2, A3, and A4 that were powered from the SUT when ACB-103 opened. The effects included a loss of illumination from the normal control room lighting and automatic illumination by emergency lighting in the control room and other plant areas. The de-energizing of Buses A1 and A2 resulted in the loss of the source of power to the condensate and feedwater systems pumps. The de-energizing of Buses A3 and A4 resulted in the loss of the source of power to the main condenser circulating water pumps, recirculation system motor generator sets/pumps, and related load centers that power numerous nonsafety-related equipment including the fuel pool cooling system pumps, station blackout diesel generator auxiliary equipment, sump pumps (in the turbine, radwaste, and reactor buildings), and RPS motor generator (MG) sets 'A' and 'B'. The de-energizing of the MG sets resulted in the consequent de-energizing of the coils of normally energized RPS, PCIS and RBIS channels 'A' and 'B' control and/or trip relays including those for a high drywell pressure and low reactor vessel water level condition. The de-energizing of the RPS, PCIS, and RBIS relays resulted in:

- Automatic actuation of the RPS (scram signal). The control rods remained in the inserted position.
- Automatic actuation of the PCIS including:

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 6 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

- A Group 1 isolation signal. The Group 1/main steam isolation valves remained closed. The Group 1/main steam drain valves MO-220-1 and MO-220-2 closed automatically. The closing of the drain valves resulted in no consequence because no steam was being produced from the reactor vessel.

- A Group 2 isolation signal. The Group 2/sample system isolation valves that were open closed automatically.

- A Group 3 isolation signal. The Group 3/RHR shut down cooling suction piping isolation valves MO-1001-47, -50 closed, and the train 'B' pump that was in service tripped. The isolation resulted in an interruption in the nonsafety-related shutdown cooling mode of RHR operation.

- A Group 6 isolation signal. The Group 6/RWCU system isolation valves closed, and the RWCU pump that was in service tripped. The isolation resulted in an interruption in RWCU system operation.

- Automatic actuation of the RBIS. The actuation resulted in the automatic start of the SGTS trains 'A' and 'B', and automatic closing of the reactor building ventilation supply and exhaust dampers.

Utility licensed operator response was in accordance with alarm response procedures and operator training. The response included entry into procedures 5.3.31, "Station Blackout," 2.4.16, and 2.4.25. Procedure 5.3.31 was entered because control room illumination by the emergency lighting system is a symptom for entering the procedure. Electrical maintenance personnel were contacted to diagnose the cause of the SUT lockout. Initial investigation indicated the lockout was the due to the actuation of the SUT lockout relay 186-4. Per procedure 1.3.11, "Reset of Lockout Relays and Protective Relay Targets," the cause of a lockout is required to be determined before a lockout relay is reset. The investigation for cause continued. Plant and operations management personnel were contacted, and personnel proceeded to Pilgrim Station to assist shift personnel.

Meanwhile, the de-energizing of Bus A3 also resulted in an interruption in the operation of the fuel pool cooling system because the system's pumps are powered from Bus A3 via load center B7 and MCC-B21. The fuel pool temperature was checked, and the fuel pool temperature was 82 degrees Fahrenheit. Ultimately, the temperature increased approximately six degrees Fahrenheit during the period of time fuel pool cooling was interrupted (about 6.5 hours).

At 0307 hours, ACB-104 was tagged and opened in accordance with REMVEC switching orders.

By 0310 hours, RPS Bus 'A' was re-energized from the RPS backup power supply from Bus A5 via load center B1, swing Bus B6, MCC-B20, 480/120 volt RPS standby transformer X20, and in-series electrical protection assemblies EPA-5 and EPA-6. This action was taken to energize the RPS channel 'A' trip relays and thereby enable a reset of the PCIS circuits. After the RPS Bus 'A' and channel 'A' trip relays were energized, the PCIS Group 3 and 6 circuits were reset. The RHR system train 'B' was returned to service in the shutdown cooling mode, and the RWCU system was returned to service by 0310 hours.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 7 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The station blackout diesel generator (SBODG) was started at 0325 hours. This action was taken as a result of lessons learned from a loss of preferred off-site 345 Kv power event that occurred on March 7, 1997 (LER 97-004-00). The SBODG engine was operated, but the SBODG was not loaded onto Bus A8 because Buses A5 and A6 were energized via the respective EDG, the 23 Kv distribution line was energized, and the shutdown transformer and Bus A8 were available (in standby service).

Weather conditions at about this time were 50 - 60 mph winds from the northeast with stronger wind gusts and heavy snow -- "white-out" conditions.

At 0339 hours, the 23 Kv distribution line de-energized. The de-energizing of the 23 Kv distribution line removed it as a source of power to the SDT and Bus A8. This, in conjunction with the previous loss of the source of preferred off-site 345 Kv power to the SUT, resulted in no off-site power source being available to power safety-related Buses A5 and A6. This condition met the emergency action level (EAL 6.3.2.1) for the declaration of an Unusual Event, and therefore, an Unusual Event was declared by the senior shift licensed operator (NWE) at 0349 hours.

The NRC Operations Center was notified of the declaration of the Unusual Event in accordance with 10 CFR 50.72 at 0402 hours. Similar notifications to agencies of the Commonwealth of Massachusetts and local communities were completed by about 0402 hours. Senior operations management arrived and assisted the NWE in discussions with the NRC Operations Center.

At 0420 hours, the NRC Operations Center called the control room for follow-up information and plant status. During the call, the Operations Center was notified of the loss of the preferred off-site 345 Kv power event (at 0257 hours) in accordance with 10 CFR 50.72.

Follow-up notifications for the Unusual Event began at 0446 hours and were subsequently made at 0538 hours and periodically thereafter until the Unusual Event was terminated (at 2347 hours).

By 0519 hours, senior operations management relieved the NWE from the duties of Emergency Director assumed by the NWE when the Unusual Event was declared.

The area electric utility (Commonwealth Electric) was contacted at 0520 hours regarding the status of the 23 Kv distribution line. No certain time frame for the re-energizing of the line could be obtained at that time.

By 0530 hours, actions were initiated to provide temporary power to fuel pool cooling pump 'A' (P-210A) in accordance with procedure 3.M.3-36.4 (rev. 3) Attachment 2, "Using B17111 as the Temporary Power Source for P-210A or P-210B." The fuel pool cooling system pump 'A' was subsequently started at about 0926 hours with the fuel pool temperature at 88 degrees Fahrenheit.

At 0601 hours, radwaste operators reported water entering the radwaste building area (-1' elevation). The water was entering this area through an electrical cable duct bank that extends from the switchyard terminal building (23' elevation) to the radwaste building. At 0602 hours, control room panel C-904L alarms C-6, "RHR B Quad Leakage," and D-6, "RCIC Quad Leakage," were received in the main control room. The alarms were the result of water detected in reactor building quadrants that contain major equipment including the reactor

core isolation cooling (RCIC) system and RHR system (train 'B') . Preparations were initiated to start the diesel engine driven air compressor to boost the non-essential air supply to the air-operated pumps that had been installed in the switchyard sump system as part of the storm preparations. The compressor and hose are located outside, in the site yard area. The storm and snow conditions delayed the use of the air operated sump pumps until after the compressor hose was located and the air compressor was moved. By 0814 hours, the air operated sump pumps were put into service. Through operation of the air operated sump pumps, water from the switchyard sump system was directed to a nearby storm drain to divert additional water from entering the radwaste building through the duct bank that extends from the switchyard terminal building to the radwaste building.

The 23 Kv distribution line was re-energized at 0643. This restored the secondary source of off-site power. The Unusual Event was not terminated at that time because the 23 Kv line voltage indications were not stable. A decision was made by the Emergency Director to remain in the Unusual Event until the SUT was re-energized from the off-site 345 Kv power source with stable voltage conditions on the 345 Kv transmission lines and 23 Kv distribution line.

At 0655 hours, procedure EOP-04, "Secondary Containment Control," was entered because three inches of water was on the RHR train 'B' quadrant floor. The entry into EOP-04 includes one inch of water in any quadrant. Radiation surveys required by EOP-04 were initiated and were completed with satisfactory results by 0910 hours.

Concurrent with the ongoing actions to supply temporary power to a fuel pool cooling system pump, additional actions were initiated to supply temporary electrical power to the sump pumps in the reactor building and radwaste building from safety-related load center B1 and nonsafety-related MCC-B45. MCC-B45 is powered from the 23 Kv line via the station services transformer X67 and MCC-B35.

At 0830 hours, the configuration of the RWCU system for the letdown of reactor vessel water was changed from the main condenser to the radwaste system. This action was taken because main condenser hotwell water level was approaching the top of the indicated normal band.

REMVEC called the control room at 0845 hours in anticipation of re-energizing line 342. REMVEC was notified that the switchyard was clear of personnel, and the line could be re-energized. Line 342 was re-energized by REMVEC at 0926 hours. ACB-103 was not closed and the SUT was not re-energized at that time because a switching order to close ACB-103 had not been issued. Line 355 was still de-energized at this time. A request to close ACB-103 via a switching order had not been made because the cause of the SUT lockout relay actuation had not been determined. Line 342 was subsequently de-energized by REMVEC at 0942 hours because of a problem(s) at the remote end of line 342.

At 1000 hours, the RHR system was removed from the shutdown cooling mode of operation. The salt service water (SSW) system train 'A' pump 'A' was stopped, and the SSW train 'A'/'B' common header valve MO-3808 was closed at 1007 hours. The RWCU system was removed from service at 1008 hours. These actions were taken as part of preparation activities to first re-align swing Bus B6 from load center B1 to load center B2, and then provide temporary power to nonsafety-related equipment including the sump pumps in the reactor building and radwaste building from load center B1.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 9 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

Safety-related swing Bus B6 was transferred from load center B1 (Bus A5) to load center B2 (Bus A6) at 1014 hours. The transfer was made in accordance with procedure 3.M.3-35 Attachment 21, "Dead Bus Transfer From B1 to B2 Supplying B6 - By Manually Opening/Closing Breakers." Electrical protection assemblies EPA-5 and EPA-6, that were powering RPS Bus 'A', RPS channel 'A' trip relays and PCIS channel 'A' trip and/or control relays, tripped as expected during the transfer and the EPAs were reset at 1015 hours. The PCIS Group 3 and 6 circuits were subsequently reset.

At 1019 hours, the RWCU system was returned to service.

The RHR system train 'B' was put into service in the shutdown cooling (SDC) mode with pump 'B' in service at 1027 hours.

By 1043 hours, a priority maintenance document (MR 19701040) was written to diagnose and correct a 125 vdc system 'B' ground alarm. The cause for the alarm was subsequently traced to the EDG 'B' engine control panel C-104B where water was dripping on the panel from the overhead EDG 'B' radiator air intake duct. Actions were taken to protect the control panel from the water by a plastic material, and the ground alarm cleared by 1102 hours. The ground alarm did not affect EDG 'B' that continued to power Bus A6 while the ground alarm condition existed.

Inspections of the reactor building quadrants were conducted and water levels in the quadrants were stable. During the inspection of the RCIC quadrant at about 1100 hours, approximately one and one-half inches of water on the floor was identified. The water level on the RHR 'B' quadrant floor was 3" - 4". The quadrants were being monitored periodically, at about 30 minute intervals. The water levels experienced in the affected reactor building areas, although >/= to the level requiring the entry into EOP-04, were much less than the acceptable water levels evaluated for pipe break or flooding analyses.

At about 1115 hours, a request to isolate the SUT for electrical testing was submitted to the control room. This action was requested after investigating the cause of the SUT lockout relay actuation to the extent possible without testing the SUT and related cabling. The SUT was later electrically isolated by about 1730 hours. The SUT and 4.16 Kv cables that connect the SUT to the 4.16 Kv buses were tested (meggared) and the tests were completed with satisfactory results by about 1900 hours. SUT oil samples were taken for testing by the off-site Boston Edison Company laboratory (Watertown).

By 1128 hours, temporary power was supplied to the turbine building sump pumps from load center B2 via safety-related MCC-B22. The turbine building sump pumps were then started. Nonsafety-related load center B3 was re-energized from load center B1 per procedure 3.M.3-35 Attachment 15, "Dead Bus Transfer - B1 Supplying B3," at 1208 hours. MCC-B13, powered by load center B3, was subsequently re-energized at 1217 hours. This action enabled the subsequent operation of the condensate transfer pump 'B', heating system train 'B' boiler and heating pump, and reactor building sump pumps.

By 1244 hours, the RHR 'B' quadrant leakage alarm was clear, and the RCIC quadrant leakage alarm was clear by 1246 hours.

Control room alarms for RHR 'B' quadrant leakage and panel C-904L window A-7, "Torus Room Trough Hi/Lo," occurred at 1250 hours. Inspection identified approximately two inches of water on the torus room floor. The sump pumps for these areas were started, and the RHR 'B' quadrant alarm cleared by 1259 hours, and the Torus room alarm cleared by 1308 hours.

By 1315 hours, EOP-03, "Primary Containment Control," was entered. A suppression pool water level of 136" is a condition for entry into EOP-03. The water level had not changed since prior to the event, but the level was recognized as meeting the entry level. Technical Specification 3.7.A.1.m pertains to the suppression pool water level and applies when the reactor vessel is pressurized or when the potential exists for draining the reactor vessel. The reactor vessel was not pressurized, and there was no potential for draining the reactor vessel. The water level was assessed. The assessment concluded there was no operational impact because the plant was in a cold shutdown condition, and the water level would be decreased after the restoration of the source of preferred off-site power. EOP-03 was exited after the assessment.

The sump pumps for the reactor building, turbine building, and radwaste building were put into service at about 1335 hours -- subject to limitations of 60 amperes for MCC-B16 and MCC-B22. The limitations were in accordance with current limitations contained in procedure 3.M.3-35 Attachment 15.

At 1411 hours, EOP-04 was exited after all reactor building quadrants and room areas were inspected and all areas had less than one inch of water.

Nonsafety-related MCC-B23 was re-energized from safety-related load center B1 via nonsafety-related load center B3 at 1509 hours. This addition resulted in a total electrical load of about 550 amperes on load center B1. At 1512 hours, nonsafety-related MCC-B25 was re-energized from load center B1 via load center B3. This addition resulted in a total electrical load of about 620 amperes on load center B1. These actions were taken to provide additional station lighting and were in accordance with procedure 3.M.3-35 Attachment 15.

At 1539 hours, the automatic reclosure feature for ACB-103 was tagged off. This action was taken in accordance with REMVEC switching orders and in preparation for re-energizing line 342. Meanwhile, an aerial (helicopter) survey of transmission line 342 had been completed with satisfactory results.

The SBODG was returned to standby service at 1635 hours. The SBODG had not been loaded onto Bus A8 at any time after being started at 0325 hours.

At 1731 hours, transmission line 342 was re-energized by REMVEC. ACB-103 was not closed because the results of SUT oil sample testing had not been completed.

Transmission line 355 was re-energized by REMVEC, and ACB-104 and ACB-105 were subsequently closed in accordance with REMVEC switching orders at 2144 hours. ACB-102 and ACB-103 were not closed because a reset of the SUT lockout relay was pending the results of the SUT oil sample testing that had not been completed.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 11 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The tests of the SUT oil samples taken earlier in the day were completed with satisfactory results by 2245 hours. Based on the acceptable oil sample test results and satisfactory results of electrical tests (Megger) of the SUT and cables to the 4.16 Kv buses performed earlier in the day, permission was given, at 2338 hours, to reset the SUT lockout relay 186-4. The lockout relay was reset, and the SUT was re-energized via ACB-102 and ACB-103 in accordance with REMVEC switching order at 2339 hours. Actions then began to re-energize the 4.16 Kv distribution system from the SUT.

The Unusual Event was terminated at 2347 hours because the SUT was energized by the preferred source of off-site power (345 Kv) and stable voltage conditions existed on the 345 Kv transmission lines and 23 Kv distribution line. Notifications that the Unusual Event had been terminated were made to the NRC Operations Center and agencies of the Commonwealth of Massachusetts. The notifications were completed by 2359 hours.

Meanwhile, Buses A1 and A2 were re-energized by 2354 hours.

Buses A3 and A4 were re-energized by 0002 hours (April 2, 1997).

The temporary electrical loads of load center B3 and related MCCs were removed from load center B1 in accordance with procedure 3.M.3-35 Attachment 16, "Dead Bus Transfer - Isolating B3 from B1 Supply." This action was completed by 0134 hours (April 2, 1997).

On April 2, 1997, at 0207 hours, the main condenser/circulating water system pump 'B' was started.

The electric motor driven air compressor K-111 was started, and the diesel engine driven air compressor was returned to standby service.

At 0239 hours, the RPS motor generator set 'B' was started, and the source of power for RPS Bus 'B' was energized from the motor generator set (powered from Bus A4 and related electrical system).

The RHR system was removed from the SDC mode of operation at 0257 hours. This action was part of preparations for transferring the source of power for Buses A5 and A6 from the EDGs to the SUT.

At 0308 hours, the source of power for Bus A5 was transferred from EDG 'A' to the SUT. EDG 'A', in service since 0234 hours on April 1, 1997, was returned to standby service at 0352 hours (April 2, 1997).

The transfer of water from the radwaste system to the condensate storage tanks began at 0321 hours.

At 0359 hours, the RHR system train 'B' was started in the SDC mode of operation with pump 'B' in service.

The source of power for Bus A6 was transferred from EDG 'B' to the SUT, and EDG 'B' was returned to standby service at 0414 hours. EDG 'B' had been in service since 0237 hours (on April 1, 1997).

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 12 of 22 |

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

By 0429 hours, the RBIS was reset, the SGTS was returned to standby service, and the reactor building ventilation system was returned to normal service.

The RPS was reset at 0505 hours.

These actions concluded the recovery from the loss of the source of preferred off-site 345 Kv power experienced at 0257 hours on April 1, 1997.

Numerous problem reports were written to document observations during and/or after the events described in this report. The problem reports included the following: PR 97.9245 for the loss of Y3/Y4 and trip of ACBs 102 and 105 at 0135 hours; PR 97.9246 for the de-energizing of line 342 and SUT lockout at 0257 hours; PR 97.9247 for the Group 3 isolation at 0257 hours; PR 97.9248 for the de-energizing of the 23 Kv line and consequent loss of the secondary source of off-site power at 0339 hours; PR 97.9249 for the 125 vdc system 'B' alarm at 1043 hours; PR 97.9250 for the delay in starting the air operated sump pumps in the 0600 - 0800 time frame; PR 97.9251 for various communications problems during the event; PR 97.9252 for problems with the switchyard sump pumps during the storm, and water in the radwaste building; PR 97.9253 for entry into EOP-04 due to water in areas in the reactor building; PR 97.9254 for the SUT lockout at 0257 hours; and PR 97.9255 for a shut down of regulating transformer X58 during the event (at 0135 hours).

A critique was conducted in accordance with procedure, "Conduct of Critiques and Investigations," on April 2, 1997. The critique was attended by applicable personnel including senior licensed operations management and personnel. The critique identified actions, recommendations, and lessons learned.

CAUSE

The direct cause of the de-energizing of panels Y3/31 and Y4/41 on April 1, 1997, at 0135 hours and 0257 hours, was the automatic shut downs of voltage regulating transformers X55 and X56. The regulating transformers were installed in 1992 via a design modification (PDC 91-59A) and associated safety evaluation (2664). Regulating transformers X55, X56, X57, and X58 were manufactured by Rapid Power Technologies, Incorporated (model number PWTAB015120E) and were supplied by EcoTech/RAM-Q, numbers E/R-2163-15-1 (X55) and E/R-2163-15-2 (X56).

The shut downs of the regulating transformers were due to brief, severe undervoltage transient conditions of less than 384 volts that lasted for approximately 6 - 8 cycles while the regulating transformers were powered from the 345 Kv transmission system via the SUT and Buses A5 and A6. During the time frames of the shut downs of the regulating transformers, the 345 Kv transmission system experienced brief but severe voltage transients -- to as low as 250 Kv. The corresponding voltage on the 480 volt load center portion of the 4.16 Kv distribution system was as low as 350 volts and lasted for approximately 6 - 8 cycles (0.130 seconds). Regulating transformers X55, X56, X57, and X58 were designed and tested to reliably regulate input voltages of 480 volts +/- 20 percent (384 - 576 volts) and provide regulated output voltages of 120 volts +/- 4 percent. Regulating transformer X58 is part of the power supply for the post accident sampling system train 'B' equipment and also shut down when X55 and X56 shut down. Regulating transformer X57 is part of the power supply for the post accident sampling system train 'A' equipment and was tagged out of service for maintenance when the storm occurred.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 13 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

Each regulating transformer contains a programmable microprocessor control unit (MCU). The MCU is contained on the tap control circuit board in the transformer's voltage regulation circuitry. The MCU is a 40 pin integrated circuit chip that senses input voltage and selects the proper voltage tap to provide the regulated 120 volt output voltage. The voltage tap selection is accomplished by the firing of silicon controlled rectifiers (SCRs) within 2 cycles (0.002 seconds) of sensing a voltage input change. The manufacturer of the regulating transformers was contacted regarding the cause of the shut downs. The software code of the MCUs was checked. Based on the software code contained in the MCUs, the manufacturer indicated the undervoltage and overvoltage shutdown functions of the regulating transformers were not disabled. The manufacturer programmed the MCUs to automatically shut down the regulating transformer if input voltage was outside the input voltage range of 480 volt +/- 20 percent (384 to 576 volts).

Specification E15A was the design document used for the purchase of the regulating transformers. The specification neither specified nor prohibited an automatic shut down of the transformers due to voltage transients less than 384 volts (greater than zero volts) and greater than 576 volts. As a result, safety evaluation 2664 did not consider the possibility of voltage transients less than 384 volts (greater than zero volts) and greater than 576 volts; consequently, the safety evaluation did not consider the possibility of an automatic shut down of the transformers. The design documentation provided by the manufacturer and supplier of the transformers did not identify an automatic shut down feature if input voltage was less than 384 volts (greater than zero volts). The lack of the identification of the feature is significant because an automatic shut down due to input voltages greater than zero volts but less than 384 volts would require a manual reset of the transformer -- versus a designed automatic reset if input voltage was zero volts. Based on NUREG-1022 guidance regarding cause classification and definition, the cause for the automatic shut downs of the regulating transformers was a deficiency in specification E15A -- it did not address the effects of 480 volt transients of less than 384 volts (greater than zero volts). The cause of the deficiency was, apparently, a cognitive (unintentional) error made by the utility electrical engineer who prepared the specification. Nuclear engineering procedure 3.08, "Specifications and Reports," governs the preparation and issuance of specifications. There were no unusual electrical engineering work location characteristics that contributed to the error. The human performance aspects of the cause of the deficiency in specification E15A will be addressed via the corrective action process (PR 97.9245). The process includes cause coding and trending. A contributing cause was the manufacturer and supplier documentation that did not identify the automatic shut down feature of the transformers due to voltage transients of less than 384 volts (greater than zero volts).

The cause of the stoppages of the SSW and RBCCW systems pumps that were in service when regulating transformers X55 and X56 automatically shut down was also due to the brief transient undervoltage conditions while the SUT was powered from the 345 Kv transmission system. The SSW train 'A' pumps (P-208A/B) and RBCCW train 'A' pumps (P-202A/B/C) are powered from Bus A5 via 480 volt load center B1 and MCC-B15. The SSW train 'B' pumps (P-208D/E) and RBCCW train 'B' pumps (P-202D/E/F) are powered from Bus A6 via 480 volt load center B2 and MCC-B14. SSW swing pump P-208C is powered from Bus A5 (or Bus A6) via load center B1 (or B2) and 480 volt swing Bus B6 and MCC-B10. The voltage transients on the 480 volt portion of the 4.16 Kv distribution system were as low as approximately 350 volts at load centers B1 and B2. The voltages at the MCCs powered by the load centers would, therefore, have been less. The contactors in the circuits that power the motors of the SSW and RBCCW pumps are rated to open if a 480 volt MCC voltage corresponding to approximately 322 volts occurs. The contactors of the SSW and RBCCW pumps that were in service opened as a result of the brief transient undervoltage conditions experienced while Buses A5 and A6 were powered from the SUT. Problem Report 97.1778 was written to document the stoppages of the SSW pump and RBCCW pumps at 0135 and 0209 hours.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 14 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The opening of ACB-103 and SUT lockout was caused by the actuation of the SUT lockout relay 186-4. The actuation of lockout relay 186-4 was caused by the actuation of one or more of seven relays that function to trip lockout relay 186-4. ACB-102 did not open as a result of the lockout because it was open at the time of the lockout. Lockout relay 186-4 is designed to actuate if a differential phase condition, ground differential condition, or phase overcurrent condition occurs. Associated with lockout relay 186-4 are three differential trip relays and three overcurrent trip relays, one for each phase. There is one ground differential trip relay associated with relay 186-4. The actuation of one or more of the differential trip relays is believed to have been the result of the effect(s) of electromotive forces during the coast-down of motors and other inductive loads (on nonsafety-related Buses A1, A2, A3, and A4) that were powered from the SUT just prior to the lockout. Therefore, the cause of the actuation of the SUT lockout relay 186-4 was due to the effects of the storm.

The 345 Kv transmission lines are equipped with sensors, communications system, and protective relaying that provide automatic protective functions and features. The features include a transfer trip function that is transmitted by the 345 Kv communications system. About 13 cycles (0.21 seconds) before the SUT lockout, the remote sections of line 342, at the Canal Station switchyard and Auburn Street, experienced a momentary fault. The line 342 fault was due to line 342 disturbances that were caused by the storm winds. The fault automatically cleared at the remote sections of line 342 but did not clear at the Pilgrim Station switchyard because of a malfunction of the line 342 communications system (carrier and telephone pilot). The communications system malfunction was a result of the storm. ACB-103 and ACB-104 did not automatically trip when line 342 de-energized because the transfer trip feature did not function due to the communications system malfunction. ACB-103 tripped open, and the SUT lockout was the result of the actuation of the SUT lockout relay 186-4.

The switchyard ACBs 102, 103, 104, and 105 and related control circuits were replaced in the 1994 - 1995 time frame. The cause analysis for the loss of off-site 345 Kv power considered the replacements relative to the potential for contributing to the SUT lockout and concluded the replacements did not contribute to the lockout.

The cause of the 23 Kv distribution line becoming de-energized was due to the effects of the storm.

The cause of the leakage of water into the radwaste building was water in the 4.16 Kv electrical cabling duct bank at the switchyard terminal building. The cables and duct bank extend underground from the terminal building to the radwaste building. The duct bank at the terminal building was not sealed -- this allowed the transport of water from the terminal building to the radwaste building. The water was due to precipitation from the storm. The loss of power at 0257 hours resulted in a loss of normal power to the switchyard sump pumps. Gradually, the water level in the switchyard increased especially in the sumps (below the 23' grade at about the 17' elevation) because of the loss of the switchyard sump pumps function. The water level in the switchyard sumps and no seals at the terminal building end of the electrical cabling duct bank resulted in the entry of water into the radwaste building, onto the radwaste building floor, and into the floor drain system.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 15 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The cause of the reactor building leakage alarms and water was, apparently, normal drainage into the reactor building floor drain system. The areas in the reactor building affected by the water are located in the lowest levels of the reactor building. The reactor building floor drain system utilizes sump pumps to transfer water to the radwaste system. The pumps were not capable of providing the transfer function while the normal source of power to the pump motors was de-energized.

The cause of the 125 vdc system 'B' ground alarm was water in the EDG 'B' engine control panel C-104B. The water resulted from the effects of the severe storm. The EDG building ventilation system separately supplies air to each EDG room and EDG radiator. The air is utilized for EDG engine combustion and engine cooling. The air is drawn from the outside atmosphere at the northern end of the EDG building. Combustion air for each EDG is drawn from the air space in the respective room and is filtered through an individual, large capacity filter supported by the roof/ceiling in each EDG room. The air is drawn indirectly from the outside atmosphere through a normally closed, automatically actuated damper. Air for cooling each EDG engine is drawn to the radiator by two separate air ducts and is exhausted to the outside atmosphere by a single forced draft fan (one for each EDG). The water was due to operation of the EDG(s) during severe storm conditions that consisted of snow driven by strong northeast winds. Some snow was, apparently, inducted into and deposited onto the interior surface(s) of the EDG 'B' radiator cooling air supply ducts. The snow subsequently melted due to the ambient air temperature inside the EDG 'B' room. The air flow resulted in the water being drawn along the inside of the air duct that extends over the EDG 'B' engine control panel C-104B. The water dripped from the air duct onto panel C-104B and ultimately caused the ground alarm experienced during the event. The EDG control panels are located in the EDG building, rooms 'A' and 'B'. Each EDG room contains three adjacent, heated, engine control panels and one separate generator control panel. For EDG 'B', the engine control panels are C-104A/B/C, and the generator control panel is C-102. For EDG 'A', the engine control panels are C-103A/B/C, and the governor control panel is C-101. The control panels are designed such that a ground condition during EDG operation does not adversely affect the operability of the respective EDG.

CORRECTIVE ACTION

The microprocessor control units (MCUs) for regulating transformers X55, X56, X57, and X58 were modified via a design modification (PDC 97-11) and related safety evaluation (number 3091) during the week of April 6, 1997. The modification disabled the undervoltage and overvoltage shut down functions. This means the transformers operate in the unregulated mode when the input voltage is outside the design range. The replacement MCUs were tested in-situ. The tests were performed (per MR 19700556) and simulated undervoltage and overvoltage conditions. During the tests, the highest and lowest transformer taps were selected by the SCRs without a shut down of the respective regulating transformer. Based on the satisfactory results of the testing of the replacement MCUs, the regulating transformers were declared operable.

Specification E15A and regulating transformers documentation (vendor manual V-1184) will be revised to reflect PDC 97-11 as part of the routine modification close-out process.

Problem Report 97.1658 was written to document that safety evaluation 2664 did not evaluate the consequences of an undervoltage transient shut down of the regulating transformers. Corrective action will be tracked by the problem report process (PR 97.1658).

Corrective action for the brief undervoltage transients on the 4.16 Kv distribution system that resulted in the stopping of the SSW and RBCCW pumps that were in service, was assessed and is not required. The pumps stopped because the contactors in the 480 volt circuits that power the pump motors opened due to the 480 volt undervoltage transients. The SSW and RBCCW systems header pressures are monitored by pressure switches that are powered from panels Y3 and Y4. The pressure switches are designed to initiate an automatic start of the pump(s) if a low SSW or RBCCW header pressure condition occurs. Moreover, the 4.16 Kv system is equipped with degraded voltage protection. The degraded voltage protection design is for a sustained degraded voltage condition on the safety-related portion of the Pilgrim Station electrical distribution system. The design includes fail-safe actuation of safety systems (e.g., RPS, PCIS, RBIS) or automatic restoration of other safety-related functions (e.g., pumps and motor operated valves). The design bounds undervoltage transients of less than 10 seconds. Therefore, no corrective action is required for the brief undervoltage transients experienced on the 4.16 Kv distribution system prior to the manual start and loading of the EDGs on Buses A5 and A6.

OTHER ACTION TAKEN OR PLANNED

The 345 Kv switchyard was visually inspected for damage and was completed with satisfactory results.

Procedure 2.1.37 (currently rev. 7) will be evaluated for improvement and revision. The focus of the evaluation is to stage the diesel engine driven air compressor and hoses in a location where the air operated sump pumps can be started in a timely manner.

Procedure 2.2.146 was revised (to rev. 13B via SRO change) during the event. The focus of the revision was SBODG engine operation without the SBODG being electrically loaded.

Procedure 2.4.16 (currently rev. 16) will be evaluated for improvement and revision. The focus of the evaluation is to provide additional alternatives for temporary power to the sump pumps in the reactor building, radwaste building, and turbine building.

Procedure 5.2.2 (currently rev. 18) will be evaluated for improvement and revision. The focus of the evaluation is to align one of the RPS buses to the backup RPS power supply.

Emergency preparedness procedure EP-IP-100, "Emergency Classification," will be evaluated. The focus of the evaluation is to include additional guidance for the Emergency Director regarding the frequency for required follow-up notifications to the Commonwealth of Massachusetts agencies and local communities during a prolonged Unusual Event.

The switchyard terminal building electrical cable duct bank will be sealed.

The switchyard sump system and/or switchyard drainage will be evaluated for improvement.

The EDG building ventilation system will be evaluated. The focus of the evaluation is to provide recommendations or actions to be taken regarding snow/ water that caused the EDG 'B' engine control panel C-104B ground alarm.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 17 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

The installation of recorders in the control room for 160' meteorological tower equipment will be evaluated.

The addition of markings for water levels in the reactor building quadrants/rooms will be evaluated. The focus of this action is to assist operators by indicating the water level(s) that correspond to the entry/exit of EOP-04.

The cell phone communications power supply will be evaluated for improvement.

These actions will be tracked by the problem report or recommendation report process.

SAFETY CONSEQUENCES

The events discussed in this report posed no threat to public health and safety.

The EDGs are designed to automatically start and power the respective safety-related 4.16 Kv buses and related load centers and motor control centers as a result of a loss of preferred off-site 345 Kv power. The EDGs were started, synchronized, loaded onto the respective Buses A5 and A6, and were operating in the isochronous mode before the loss of preferred off-site 345 Kv power occurred. The EDG 'B' engine control panel C-104B ground alarm condition did not affect the operability of EDG 'B'.

The EDGs operated for approximately 25 hours. During the period of time the EDGs operated, the inventory in the fuel storage tanks for EDG 'A' and 'B' decreased slightly. For EDG 'A', the fuel tank inventory decreased from approximately 93 percent to approximately 85 percent. For EDG 'B', the fuel tank inventory decreased from approximately 90 percent to approximately 80 percent. The inventory for each EDG did not decrease to less than the inventory of 80 percent that is used for ordering EDG fuel.

Bus A8 is the backup source of power to safety-related Buses A5 and A6. Bus A8 is designed to be powered from the shutdown transformer (SDT) or station blackout diesel generator (SBODG). The SDT is powered from the 23 Kv distribution system. The SDT has sufficient capacity to energize Buses A5 and A6 and related electrical loads powered from Bus A5 and A6. The SBODG has sufficient capacity to power Bus A5 or A6 and selected electrical loads powered from Bus A5 or Bus A6. The SBODG was not started and loaded onto Bus A8 as a result of the loss of preferred off-site 345 Kv power because the off-site 23 Kv distribution line was energized at the time of the event. The SBODG was started but was not loaded onto Bus A8 as a result of the de-energizing of the 23 Kv distribution line because Buses A5 and A6 were energized by the EDGs when the 23 Kv distribution line de-energized. The SBODG was operated for approximately 13 hours without being loaded onto Bus A8. The SBODG was not adversely affected as a result of being operated but not loaded onto Bus A8.

The 125 vdc system consists of Buses 'A' and 'B'. Each bus is normally powered by a battery charger that is powered from safety-related Buses A5 and A6 and the respective electrical system. A backup battery charger is capable of powering either 125 vdc bus, and the charger is powered from safety-related swing Bus B6 that can be powered from Bus A5 or Bus A6. In the event the normal and/or backup battery charger(s) were to become inoperable, the 125 vdc bus is designed to be powered by the respective 125 vdc battery. The 125 vdc system is designed to detect a ground condition on Bus 'A' or Bus 'B'. The 125 vdc system was not adversely affected by the EDG 'B' panel C-104B ground alarm condition.

The interruption (about 6.5 hours) in spent fuel pool cooling provided by the fuel pool cooling system resulted in a spent fuel pool temperature increase of six degrees, from approximately 82 to 88 degrees Fahrenheit. There were approximately 2,553 spent fuel assemblies in the spent fuel pool at the time of the event.

The temporary interruptions in the nonsafety-related shutdown cooling mode of RHR system operation resulted in a minimal increase in the reactor vessel water temperature.

The automatic actuations of the RPS, PCIS, and RBIS were the designed response to the loss of 120 volt ac power to the coils of the normally energized relays that are part of the RPS, PCIS, and RBIS circuitry.

The maximum level of water that occurred in any of the reactor building areas was approximately 4". The level, although requiring entry into EOP-04, was less than the maximum water level of approximately 21" evaluated in pipe break and flooding analyses.

Regulating transformers X55 and X56 shut down (de-energized) unexpectedly due to brief, severe undervoltage transients, at 0135 hours and 0209 hours, while the 4.16 Kv distribution system, including Buses A5 and A6 and related electrical systems were energized from off-site 345 Kv power via the SUT. Safety-related panels Y3/31 are powered from Bus A5 via 480 volt load center B1, MCC-B17, and 480/120 volt regulating transformer X55. Similarly, safety-related panels Y4/41 are powered from Bus A6 via 480 volt load center B2, MCC-B18, and 480/120 volt regulating transformer X56. Circuits powered from panels Y3/31 and Y4/41 include:

- Normally energized logic relays that are part of the inboard and outboard circuitry of the PCIS and RBIS.
- Torus temperature and pressure monitoring systems 'A' and 'B'.
- Hydrogen/oxygen monitoring systems 'A' and 'B'.
- Post accident monitoring systems 'A' and 'B'.
- Instrument and control system 'A' and 'B'.
- Noble gas effluent radiation monitors 1001-608, 1001-609, and 1001-610.
- Containment atmosphere control system 'A' and 'B'.
- Anticipated transient without scram (ATWS) division 1 and 2 alternate current power supplies. The system is also equipped with redundant power supplies that are powered by 125 vdc power. The loss of power to the 120 vac power supplies of this system does not adversely affect the system.
- Analog trip system 'A' and 'B' alternate current power supplies. The system is also equipped with redundant power supplies that are powered by 125 vdc power. The loss of power to the 120 vac power supplies of this system does not adversely affect the system.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 19 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

- Salt service water (SSW) system train 'A' and 'B' pressure switches and reactor building closed cooling water (RBCCW) system train 'A' and 'B' pressure switches. The pressure switches monitor SSW and RBCCW header pressures, and provide the automatic start signal(s) to the systems' pumps if sufficient header pressure is not present after applicable time delay(s).

The Pilgrim Station electrical design includes the automatic re-energizing of Buses A5 and/or A6 and related electrical system, including Y3/31 and/or Y4/41, if a loss of off-site power and a design bases loss of coolant accident occurs. A loss of off-site power did not occur for the two instances that involved the de-energizing of panels Y3/31 and Y4/41. If a loss of off-site power had occurred while regulating transformer X55 (X56) was energized from preferred off-site power via Bus A5 (A6) and a loss of coolant accident were to occur, EDG 'A' (EDG 'B') is designed to automatically start and re-energize Bus A5 (Bus A6) in approximately 10 seconds. During the period of time between the loss of off-site power and the re-energizing of Bus A5 (Bus A6) and related electrical loads, a loss of input 480 volt power to the respective regulating transformer -- zero volts -- would occur as assumed in the design. Regulating transformer X55 (X56) is designed to automatically reset if a loss of input 480 volt power (zero volts) occurs. After input power is supplied to regulating transformer X55 (X56) from Bus A5 (A6), panels Y3/31 (panels Y4/41) would re-energize automatically. During the period of time panels Y3 and Y4 are de-energized, the SSW trains 'A' and 'B' pumps and swing pump 'C', and the RBCCW trains 'A' and 'B' pumps would not be capable of automatically starting as assumed in the design. The manual start function of the pumps is not affected while the respective panel is de-energized.

Panels Y3/31 and Y41 de-energized twice, once for a maximum of approximately 24 minutes. The significance of the effects of a simultaneous loss of power to the panels powered by regulating transformers X55 and X56 was assessed previously (LER 93-004-00). The assessment concluded the loss of power to panels Y3/31 and/or Y4/41 is detectable, the actions to re-energize the panels are proceduralized, immediate safety functions are not adversely affected, and the panels can be powered in sufficient time to support longer term safety functions. The assessment for the de-energizing of the panels for this event is the same as the assessment for that event (LER 93-004-00).

Technical specification 3.2.B/table 3.2.B includes degraded voltage and loss of voltage protection. The trip settings of the Bus A5 and Bus A6 degraded voltage annunciation relays is approximately 3,958 volts with a time delay of approximately 10.24 seconds. The durations of the transient voltage conditions experienced when regulating transformers X55 and X56 shut down was less than the time delay of the degraded voltage alarm relays. Similarly, the trip settings of the SUT degraded voltage relays is approximately 3,878 volts with a time delay of approximately 10.24 seconds. The durations of the transient voltage conditions experienced when the SUT was powered from the 345 Kv system was less than the time delay of the degraded voltage trip relays. The trip function of the SUT loss of voltage relays is designed to occur at zero volts with a time delay of approximately one second. The transient voltage conditions experienced while the SUT was energized by the 345 Kv system were not low enough for a sufficient period to result in the actuation of the loss of voltage relays.

This report is submitted in accordance with 10 CFR subpart (a)(2)(ii)(B) because the undervoltage shut downs of the regulating transformers, although in accordance with the software code contained in the respective transformer microprocessor control unit, was outside the Pilgrim Station design basis.

This report is also submitted in accordance with subpart (a)(2)(iv) because the PCIS and RBIS actuations, although a designed response to the de-energizing of the coils of the normally-energized trip and control relays, was not planned.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 20 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

This report is also submitted in accordance with subpart (a)(2)(vii)(B) because the de-energizing of safeguards Buses 'A' and 'B', a consequence of the automatic shut down(s) of regulating transformers X55 and X56, affected more than one train in more than one system.

SIMILARITY TO PREVIOUS EVENTS

A review for similarity was conducted of Pilgrim Station Licensee Event Reports (LERs) submitted since 1984. The review focused on losses of the preferred source of off-site power (345 Kv) and losses of the source of secondary off-site power (23 Kv distribution line). The review identified previous instances when a loss of the source of preferred or secondary off-site power occurred separately during storm and non-storm conditions. The review identified instances when the secondary source of off-site power was either de-energized when the preferred source of off-site power (345 Kv) became de-energized, or became de-energized after the 345 Kv power source became de-energized. The instances were reported in LERs 86-027-01, 87-014-01, and 91-024-00. The events reported in LERs 86-027-01, 87-014-01, and 91-024-00 occurred before the switchyard enhancements that were made in the 1994 - 1995 time frame. The enhancements included the replacement of the 345 Kv switchyard air circuit breakers and related control circuits, and the replacement or recoating of the 345 Kv switchyard insulators.

A review for similarity was also conducted of Pilgrim Station LERs submitted since 1984 that involved regulating transformers X55 or X56. The review identified an event reported in LER 93-004-00 that involved the de-energizing of safeguards Buses 'A' and 'B' that was due to the trip of the input circuit breakers to regulating transformers X55 and X56.

For LER 93-004-00, an automatic scram resulting from a load rejection while at 100 percent reactor power occurred during a severe storm on March 13, 1993. Safeguards Bus 'A' panels Y3 and Y31, and safeguards Bus 'B' panels Y4 and Y41 became de-energized (for 28 minutes) during the event. The cause of panels Y3/31 and Y4/41 becoming de-energized was the trip of the main input circuit breakers of voltage regulating transformers X55 and X56. The regulating transformers, and internal main input circuit breakers, were installed during the mid-cycle outage in 1992 (PDC 91-59A). The regulating transformers replaced the previously installed fixed tap transformers that did not have internal circuit breakers. The cause of the trip of the main input circuit breakers for regulating transformers X55 and X56 was low instantaneous trip settings. The as-found nominal trip settings of the breakers was '2' (900 amperes) and '3' (1000 amperes), respectively. The trip settings had been set at '5' (1200 amperes) and tested at the supplier's facility in accordance with the approved dedication plan test instructions. Supplier test documents indicate the settings were left at '5'. The receipt inspection of X55 and X56 included documentation, physical damage, identification and/or markings protective covers and seals, cleanliness, and electrical tests. The receipt inspection, however, did not include a requirement to check or verify the trip settings. The pre-operational testing of the transformers included voltage regulation, input breaker contact resistance, current leakage, initial startup and energizing, transformer ratio, and relay and alarm functional tests. The testing did not include a requirement to check or verify the trip settings since there were no installation or testing activities that would have caused the settings to be changed. The root cause analysis concluded the most likely cause was an unauthorized change to the trip settings. The root cause analysis could not determine when the change occurred. Based on the root cause analysis findings, and review of Pilgrim Station corrective action program documents and LERs, the unauthorized change was an isolated occurrence. Corrective action taken included an increase in the trip settings. The increased trip settings included additional margin to preclude a trip of the main input breakers.

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 21 of 22 |

**TEXT** (If more space is required, use additional copies of NRC Form 366A) **(17)**

ENERGY INDUSTRY IDENTIFICATION SYSTEM (EIIS) CODES

The EIIS codes for this report are as follows:

| COMPONENTS | CODES |
|---|---|
| Circuit breaker, AC | 52 |
| Compressor | CMP |
| Conduit | CND |
| Cooler | CLR |
| Drain | DRN |
| Duct | DUCT |
| Generator (EDG, SBODG) | DG |
| Motor | MO |
| Pump | P |
| Rectifier, silicon controlled | SCR |
| Relay | RLY |
| Relay, differential protective | 87 |
| Relay, locking-out (186-4) | 86 |
| Relay, tripping | 94 |
| Switch, pressure | PS |
| Tank (sump) | TK |
| Transformer (X55, X56, X58) | XMFR |
| Valve, isolation | ISV |

| SYSTEMS | |
|---|---|
| Component/closed cooling water system (RBCCW) | CC |
| Containment isolation control system (PCIS/RBIS) | JM |
| Emergency DC lighting system | FH |
| Emergency on-site power supply system (EDGs) | EK |
| Engineered safety features actuation system (RPS/PCIS/RBIS) | JE |
| Essential service water system (SSW) | BI |
| Fuel pool cooling system | DA |
| Instrument air system | LD |
| Low-voltage power system (480 vac) - Class 1E | ED |
| Medium-voltage power system (4.16 Kv) - Class 1E | EB |
| Nonessential air system | LF |
| Normal AC lighting system | FF |
| Plant protection system (RPS) | JC |
| Radwaste building | NE |
| Reactor building | NG |
| Standby gas treatment system (SGTS) | BH |
| Switchyard system (ACBs 102, 103, 104, and 105) | FK |
| Turbine building | NM |

# LICENSEE EVENT REPORT (LER)
## TEXT CONTINUATION

| FACILITY NAME (1) | DOCKET NUMBER (2) | LER NUMBER (6) | | | PAGE (3) |
|---|---|---|---|---|---|
| | | YEAR | SEQUENTIAL NUMBER | REVISION NUMBER | |
| PILGRIM NUCLEAR POWER STATION | 05000-293 | 97 | 007 | 00 | 22 of 22 |

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)